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Title: Experimental Rexolite Outgassing Measurements for Particle Accelerator Technology Development

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Engineering in 5

Experimental Rexolite Outgassing Measurements for Particle Accelerator Technology Development

Jay Chen

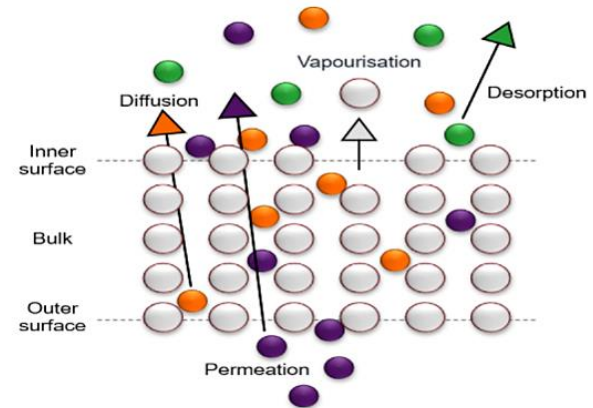
February 23rd

LA-UR-21-XXXX

Problem: Rexolite Outgassing

Outgassing

- The release of gases that were previously trapped, dissolved, or adsorbed on the surface
- Contributes to the gas load of a vacuum system
- All materials are active sources of outgassing
- Plastics typically have higher outgassing rates than metals



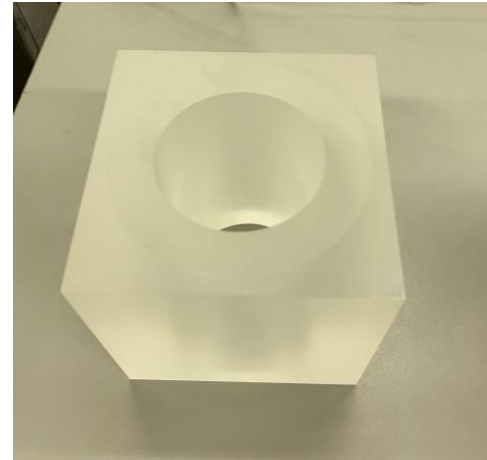
Mechanisms contributing to outgassing

(Chew, A. <https://www.vacuumscienceworld.com/blog/outgassing>)

Problem: Rexolite Outgassing

Rexolite

- A cross-linked polystyrene based plastic with excellent electrical insulation properties
- Poor outgassing performance relative to traditional vacuum materials (steel and aluminum)
- Rexolite's vacuum properties have been studied in the past by Los Alamos National Lab (LANL) & Sandia National Lab (SNL)
- Results varied widely test to test



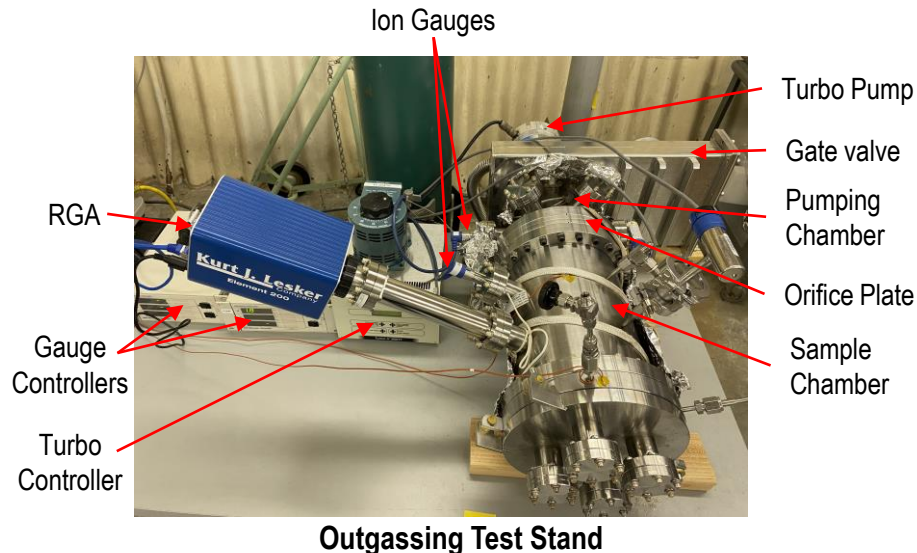
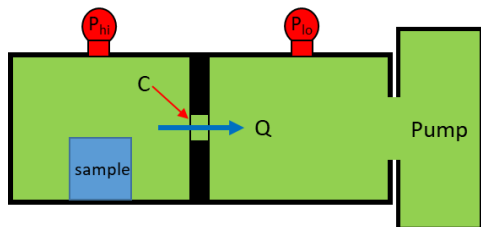
Approach: Vacuum Test Stand for studying Rexolite

Rexolite Samples' Preparation

- Vacuum bake-out @ 150°C
- Vacuum, dry nitrogen, and ambient air storage

Throughput Method

- Throughput is the product of the pressure differential and the conductance of the orifice [$Q = C(P_{hi} - P_{lo})$]
- Measured outgassing rate (q_{meas}) includes outgassing of the sample and the chamber
- Sample Outgassing rate ($q_{true,s}$) deducts the outgassing of the chamber and includes the sticking factors of all surfaces

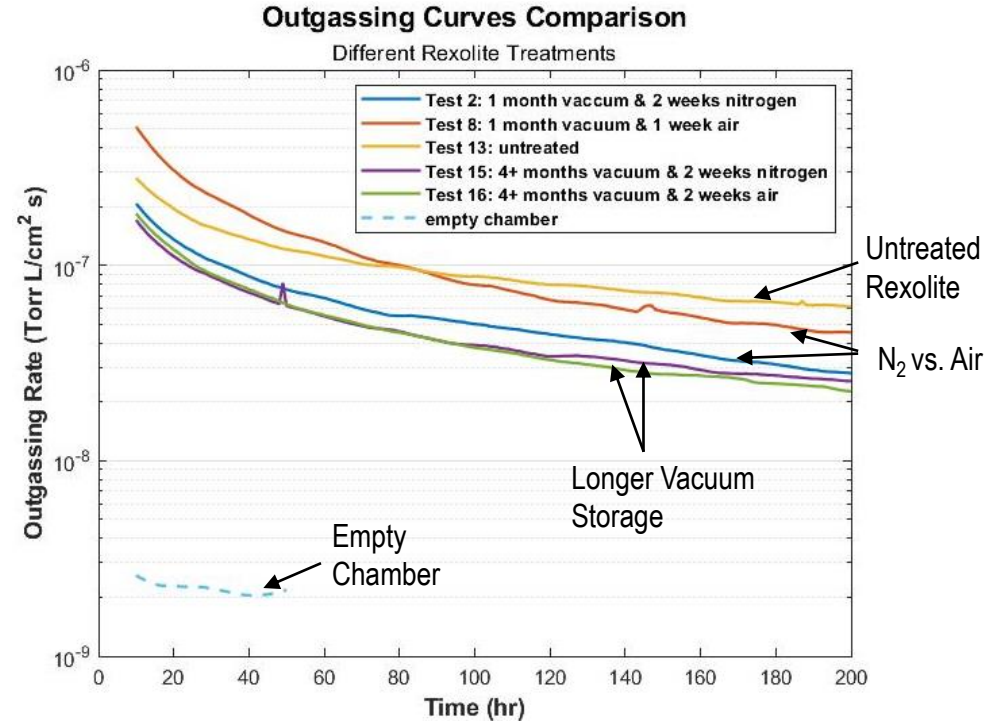
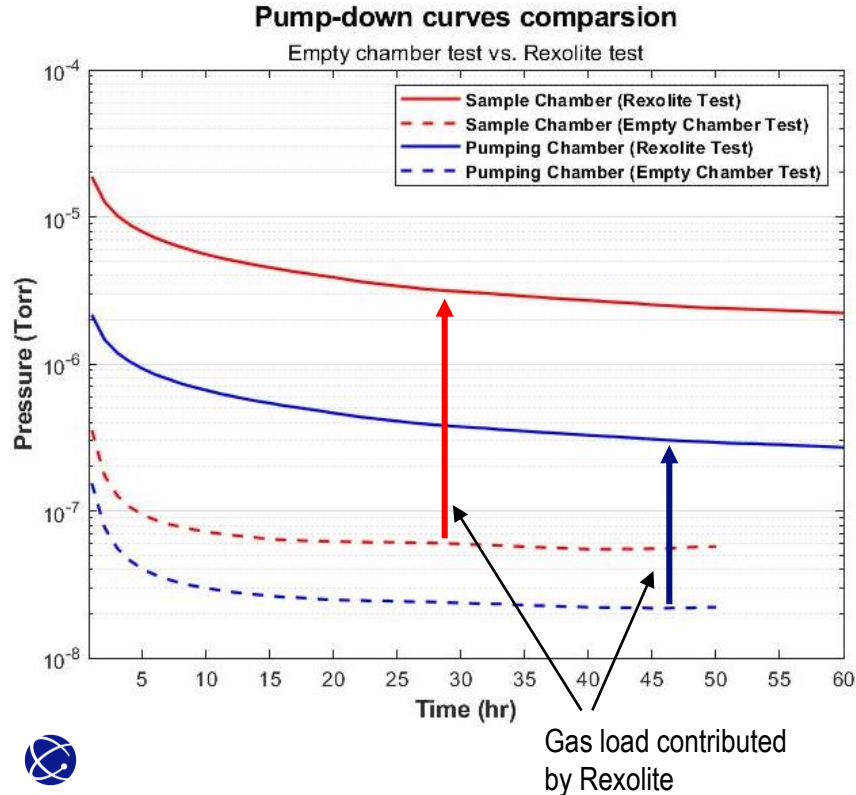


$$q_{meas} = \frac{Q}{A_c} \rightarrow \frac{q_{true}}{q_{meas}} = \frac{1+\eta}{\eta}; \eta = \frac{a}{A_c S_c}$$

$$q_{true,s} = q_{meas,s} \left(1 + \frac{1}{\eta_c}\right) + \frac{1}{\eta_s} q_{meas,s} + \frac{1}{\eta_s} \frac{q_{true,c}}{1 + \frac{1}{\eta_c}} \left(\frac{A_c}{A_s}\right)$$

2/15/2022

Results: Pump-down Curve & Outgassing Curve



Conclusions

Findings

- Baking Rexolite removes gases trapped on the surface and in the bulk material, reduces outgassing, and reduces gas load inside the vacuum system
- Outgassing performance degrades over time for samples exposed to ambient air and dry nitrogen
- Longer vacuum storage leads to lower outgassing rates in the observed time frame

Future Work

- Demonstrate the repeatability of enhancing Rexolite's outgassing performance with long term vacuum storage
- Develop optimized treatment and handling procedures for Rexolite used in vacuum systems

